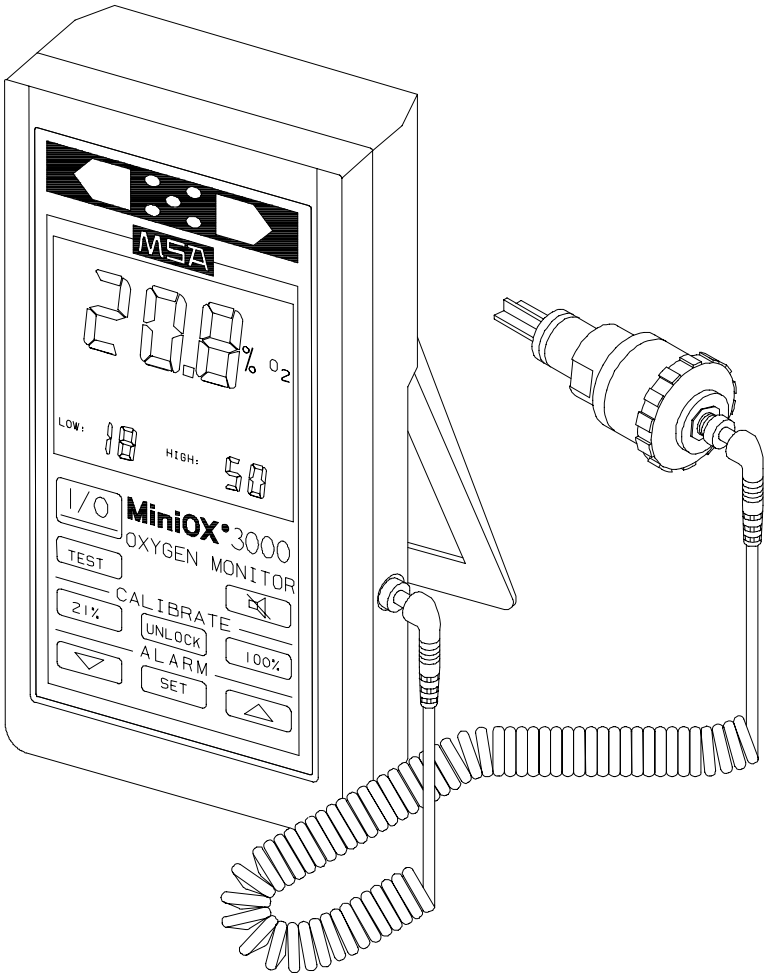
Medical Products

MiniOX® 3000
Oxygen Monitor



Operation Manual

Customer Service: 1-800-851-4500
Repair: 1-800-672-4678 Extension 8642 or 724-776-8642
Fax: 724-776-8885

Manufactured by
MINE SAFETY APPLIANCES COMPANY
PITTSBURGH, PENNSYLVANIA 15230

FEDERAL (U.S.) LAW RESTRICTS THIS PRODUCT TO SALE BY OR ON THE ORDER OF A PHYSICIAN

(L) REV 3 1098 **814358**

⚠ WARNING

THIS MANUAL MUST BE CAREFULLY READ AND FOLLOWED BY ALL INDIVIDUALS WHO WILL HAVE THE RESPONSIBILITY FOR INSTALLING OR USING THIS PRODUCT. THIS OXYGEN MONITOR WILL PERFORM AS DESIGNED ONLY IF INSTALLED AND USED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS; OTHERWISE, IT COULD FAIL TO PERFORM AS DESIGNED AND JEOPARDIZE THE WELL-BEING OF THE PATIENT AND/OR HEALTH CARE PROFESSIONAL.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not installed and used in accordance with the instructions in this manual. Please protect yourself and your patients by following them. We encourage our customers to write or call regarding this equipment for any additional information relative to use.

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MSA
Medical Instrument Warranty

MSA warrants to the purchaser of this product that the MiniOX 3000 Monitor will be free from mechanical defect or faulty workmanship for a period of one (1) year on the instrument. The associated electrochemical cell will be replaced free of charge for a period of one (1) year from date of manufacture, provided it is maintained and used in accordance with MSA's instructions. MSA shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of MSA has any authority to bind MSA to any affirmation, representation or warranty concerning this product.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. MSA SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedy

By acceptance and use of this product, purchaser agrees that its sole and exclusive remedy for breach of the warranty set forth herein, shall be the repair and/or replacement (at MSA's option) of any equipment or parts thereof, which after examination by MSA is proven to be defective. Replacement equipment and/or parts will be provided at no cost to Purchaser, F.O.B. MSA's customer service facility. Failure of MSA to successfully repair any nonconforming product shall not cause the remedy established hereby to fail of its essential purpose.

Exclusion of Consequential Damages

PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT UNDER NO CIRCUMSTANCES WILL MSA BE LIABLE TO PURCHASER FOR ECONOMIC, SPECIAL, INCIDENTAL OR CONSEQUENTAL DAMAGES OR LOSSES OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS AND ANY OTHER LOSS CAUSED BY NONOPERATION OF THE GOODS. THIS EXCLUSION IS APPLICABLE TO CLAIMS FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST MSA.

Definition of Warnings and Cautions

⚠ WARNING

Statement citing a potential safety hazard and possible injury to yourself or others.

⚠ CAUTION

Statement citing a possibility of damage to the instrument or other property.

NOTE

Advisory on instrument function.

CE

This device complies with Council Directive 89/336/EEC, relating to Electromagnetic compatibility.

Cet appareil est conforme aux exigences de la directive 89/336/CEE relative à la compatibilité électromagnétique.

Dieses Gerät erfüllt die Bestimmungen der Richtlinie 89/336/CEE des Europarates über elektromagnetische Kompatibilität.

Questo dispositivo è conforme alla Direttiva 89/336/CEE, relativa alla compatibilità elettromagnetica.

Este dispositivo cumple con la Directiva del Consejo 89/336/CEE relacionada con la compatibilidad electromagnética.

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Section 1
Introduction

The MiniOX 3000 Oxygen Monitor provides continuous, direct monitoring of oxygen mixtures in a variety of applications, including:

- Respiratory Therapy (e.g., respirators, ventilators, pediatric incubators)
- Anesthesiology (e.g., anesthesia machines)
- Oxygen Therapy (e.g., oxygen tents).

The monitor is for use by trained health care professionals:

- under the supervision, or on the order, of a physician
- in a hospital or clinical setting
- during emergency transport.

General Description

Battery-operated and microprocessor-controlled, the MiniOX 3000 Oxygen Monitor measures oxygen concentrations in the 0% to 100% range. The monitor's performance features ensure reliable and accurate oxygen measurement. These features include:

- calibration function
- high and low oxygen concentration alarms
- low and depleted battery alarms
- oxygen sensor indicator
- automatic error detection
- battery test
- oxygen alarm test.

The calibration function allows calibration of the device against room air (defined as oxygen concentration of 20.8%) or 100% O_2. Audible and visual alarms alert the operator when monitor calibration is required.

High and low oxygen concentration alarms may be set in the ranges of:

- 15% to 100% (high alarm) and
- 16% to 99% (low alarm)

or the default high/low settings may be used (50% and 18%, respectively).

Audible and visual alarms activate when oxygen concentrations:

- fall below the preset (or default) low alarm setting or
- rise above the preset (or default) high alarm setting.

The MiniOX 3000 Oxygen Monitor:

- detects low and depleted battery conditions
- activates audible and visual alarms
- alarms for:
  - sensor disconnection or malfunction
  - various internal operating errors.

The MiniOX 3000 Oxygen Monitor conducts self-checks:

- at power-up (battery installation)
- at turn-on
- during operation.

Additionally, the monitor has two operator-initiated test functions:

- The Alarm Test verifies the operation of the high and low oxygen level alarms
- The Battery Test assesses the relative remaining battery life.

The MiniOX 3000 Oxygen Monitor consists of two components: the instrument and the oxygen sensor.

The front of the hand-held instrument features:

- a touch-sensitive keypad
- a liquid crystal display (LCD) that shows:
  - monitor status
  - continuous oxygen concentrations
  - preset alarm levels
- two red light-emitting diodes (LEDs) which serve as visual alarms.

The back of the instrument case features:

- a bail bar to allow the instrument to "stand" on a horizontal surface during monitoring operations
- a plastic wedge that slides into an optional bracket for mounting the instrument on a horizontal or vertical pole.

The oxygen sensor used in the MiniOX 3000 Oxygen Monitor is the same type used in MSA oxygen monitoring medical devices for the past 15 years. Connected to the instrument by a coiled cable, the galvanic oxygen sensor consists of a deflector assembly and a plastic housing containing two electrodes. A coiled cable connects the sensor to the instrument. Plugs at each end of the cable snap into jacks (one located in the

sensor housing and one located in the instrument) and are held securely in place by twist collars.

Accessories

In addition to the Mounting Bracket, the device has two accessories:

- Tee Adaptor
- Retaining Strap.

The oxygen sensor is introduced into a breathing circuit through an MSA Tee Adaptor connecting two lengths of tubing. The Sensor/Tee Assembly is positioned with the sensor deflector pointing downward to ensure that moisture does not collect on the sensor membrane. The Retaining Strap ensures that the sensor remains securely in place in the Tee Adaptor.

See the following appendices:

- Appendix A, Specifications
- Appendix F, Accessories/Replacement Parts
- Appendix G, Parts List.

Operating Principles

MiniOX 3000 Oxygen Sensor

The oxygen sensor includes two electrodes:

- a gold cathode exposed to the atmosphere through a fluoropolymer membrane
- a lead anode submersed in a potassium hydroxide solution.

When oxygen diffuses through the membrane, the electrochemical reduction of oxygen on the cathode and the corresponding oxidation on the anode generate an electrical current proportional to the partial pressure of oxygen in the sample atmosphere. The instrument temperature compensates, amplifies, and converts the electrical current, displaying O_2 values.

The MSA oxygen sensor is self-zeroing; when no oxygen is present:

- no current is produced
- 0% oxygen is displayed.

The sensor has a minimal response to gases other than oxygen (see Appendix C, Interferant Gases and Vapors).

MiniOX 3000 Instrument

The MiniOX 3000 Oxygen Monitor is battery-powered and microprocessor-controlled. The microprocessor:

- provides the operator interface
- controls internal functions
- monitors data and system status.

Operator Interface

When the operator enters commands using the keypad, the microprocessor interprets these commands and responds by:

- displaying text in the LCD
- activating the LEDs and/or
- emitting audible tones.

Internal Functions

During operation, the microprocessor coordinates all internal functions including:

- self-testing
- response to keypad commands
- data collection
- display update
- confirmation that a programmed sequence is properly followed.

Data and System Status

The signal from the oxygen sensor is amplified and converted to a digital value through electronic circuitry. Following software compensation, the microprocessor:

- compares current data to preselected values
- displays the updated O_2 concentration
- if appropriate, activates audible and visual alarms.

The microprocessor also monitors internal systems, indicating such operating conditions as:

- calibration required
- low battery voltage
- sensor disconnect, and system error.

Performance Features

Calibration

The MiniOX 3000 Oxygen Monitor must be calibrated:

- daily, while in operation
- each time the monitor is turned ON
- following sensor disconnection/reconnection
- when environmental conditions (temperature, pressure and humidity) change.

When a MiniOX 3000 Oxygen Monitor with a sensor connected is turned ON, the monitor performs a self-test and a calibration requirement occurs.

- "CAL" flashes on the display, telling the operator to carry out the calibration procedure.

The calibration procedure is initiated by exposing the sensor to a calibration gas [either room air (defined as oxygen concentration of 20.8%) or 100% oxygen] and pressing the corresponding key on the keypad. The following appears on the display:

- "CAL LOCKED"
- the selected calibration gas concentration.

When the **unlock** key is pressed the monitor displays:

- "CAL"
- a 10-segment bar graph which "counts down" two seconds per bar for 20 seconds.

The monitor automatically calibrates to the selected concentration. At the end of the 20 seconds, the monitor:

- emits a beep indicating that calibration is complete
- enters the operating mode.

See Section 3, "Calibration."

Low/High Oxygen Concentration Alarms

The MiniOX 3000 Oxygen Monitor has audible and visual alarms that activate when oxygen concentrations exceed preset low or high alarm settings. Default settings are 18% and 50%, respectively; however, the operator may select alarm levels between 15% and 100%. See Section 3, "Setting the Alarms."

When the MiniOX 3000 Oxygen Monitor detects an oxygen concentration that exceeds the preset alarm limit:

- the red LED for that alarm flashes
- an audible alarm activates
- the measured concentration appears in the display.

The operator can silence the audible alarm for three 30-second intervals for a total of 90 seconds; however, the visual alarm continues to flash. At the end of the silence period, the audible alarm reactivates if the alarm condition is not corrected. See Section 3, "Silencing an Alarm."

Low Battery Alarms

The MiniOX 3000 Oxygen Monitor features a two-stage battery alarm that warns of depleted and expired battery voltage:

- The first alarm alerts the operator that the monitor has approximately six hours of operating time remaining:
  - a warning message appears in the display
  - an audible alarm sounds at 30-second intervals.
- If the operator does not replace the battery after this alarm, a second low battery alarm activates when the battery is no longer able to support monitoring. The monitor:
  - displays a warning message
  - activates an audible and visual alarm (See Section 3, "Low Battery Alarms").

Sensor Indicator

During monitoring, the MiniOX 3000 Oxygen Monitor displays a warning message; audible and visual alarms activate if:

- the oxygen sensor becomes disconnected
- the cable fails or disconnects from the sensor or instrument
- the sensor membrane is perforated
- the thermistor circuit opens.

Calibration Needed Indicator

The MiniOX 3000 Oxygen Monitor flashes "CAL":

- when the monitor is turned ON
- following sensor disconnection/reconnection.

If a calibration is performed using a calibration gas other than room air or 100% oxygen, or if the microprocessor detects a calibration error during normal operation:

- the display flashes a warning message: "CAL" and "ERR" five times; then, "CAL" flashes
- audible and visual alarms activate, alerting the operator that recalibration is required. See Section 3, "Calibration."

Error Handling

The MiniOX 3000 Oxygen Monitor performs a self-test:

- when it is turned ON
- after a battery is installed (power-up)
- during routing monitoring.

If the microprocessor detects an error during these routine self-tests or during monitoring,

- the display flashes:
  - "ERR"
  - an error code
- audible and visual alarms activate
- the monitor ceases to operate until the appropriate service is performed. See Appendix E, "Error Codes."

To reset the monitor, press **SET** or turn the monitor OFF, then ON (press **I/O** twice). For further details, see Appendix E, "Error Codes."

Test Functions

In addition to alarms that alert the operator to low and expired battery voltage, the MiniOX 3000 Oxygen Monitor features:

- a keypad function that allows the operator to check the relative battery life at any time. See Section 3, "Test Functions."
- a test function that allows the operator to ensure that the high and low alarms activate at the preset alarm levels. See Section 3, "Test Functions."

Radio Frequency/Electromagnetic Insensitivity

The MiniOX 3000 Oxygen Monitor is designed to be insensitive to radio frequency interference (RFI) and electromagnetic interference (EMI). However, if the monitor comes in close contact with an RF transmitter or local electrical disturbance, an erratic reading may occur.

Section 2
Setting Up the MiniOX 3000 Oxygen Monitor

The MiniOX 3000 Oxygen Monitor is packaged in a shipping carton suitable for instrument storage. If there is obvious damage to the shipping carton or its contents, contact MSA Repair at:

800-672-4678, extension 8642.

To set up the monitor:

1. Verify that you have the following (see FIGURE 2-1):
   - MiniOX 3000 Oxygen Monitor
   - Oxygen Sensor and deflector in sealed package
   - 10-foot coiled cable
   - Tee adaptor
   - Sensor retaining strap
   - 9-volt alkaline battery
   - MiniOX 3000 Operation Manual.
2. Check the sensor's manufacturing date on the sensor package. If the sensor is put into service within six months after this date, the sensor will meet performance specifications.
3. Remove the sensor from the sealed package and attach it to the coiled cable.
   a. Firmly press the connector until it snaps into place; tighten the twist collar.
   b. Insert the opposite end of the coiled cable into the jack on the side panel of the instrument; tighten the twist collar.
4. Remove the deflector from the sealed package.

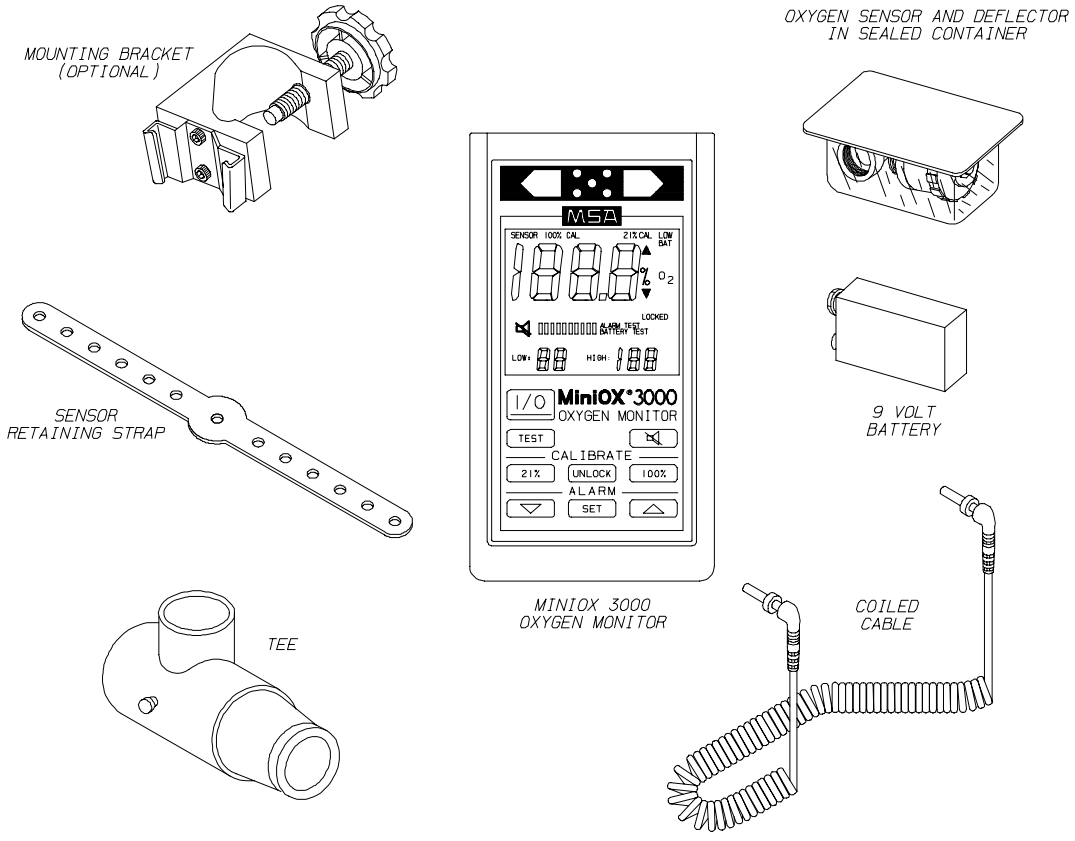

Figure 2-1.
Miniox 3000 Oxygen Monitor

a. Insert the gasket into the open end of the deflector, ensuring that the gasket is properly seated within the deflector.

b. Gently screw the deflector onto the sensor. (For monitoring in a breathing circuit, see Section 3, "Installing the Sensor in a Breathing Circuit."

5. Unscrew the two battery cover screws on the back of the instrument.

   a. Remove the cover.

   b. Install the battery (See Section 4, "Battery Replacement" for full battery installation instructions.)

   After battery installation:

   - the display flashes
   - the instrument performs a self-test
   - then turns OFF.

6. Proceed to Section 3, "Operation."

NOTE: Do not handle the sensor unnecessarily during calibration or use. Body heat can cause the sensor's thermistor to change disproportionately to the change in gas sample temperature at the sensing electrode. This can produce some error until thermal equilibrium is restored.

See Appendix F, "Accessories/Replacement Parts" and Appendix G, "Parts List" for ordering MiniOX 3000 Monitor accessories and replacement parts (FIGURE 2-2).

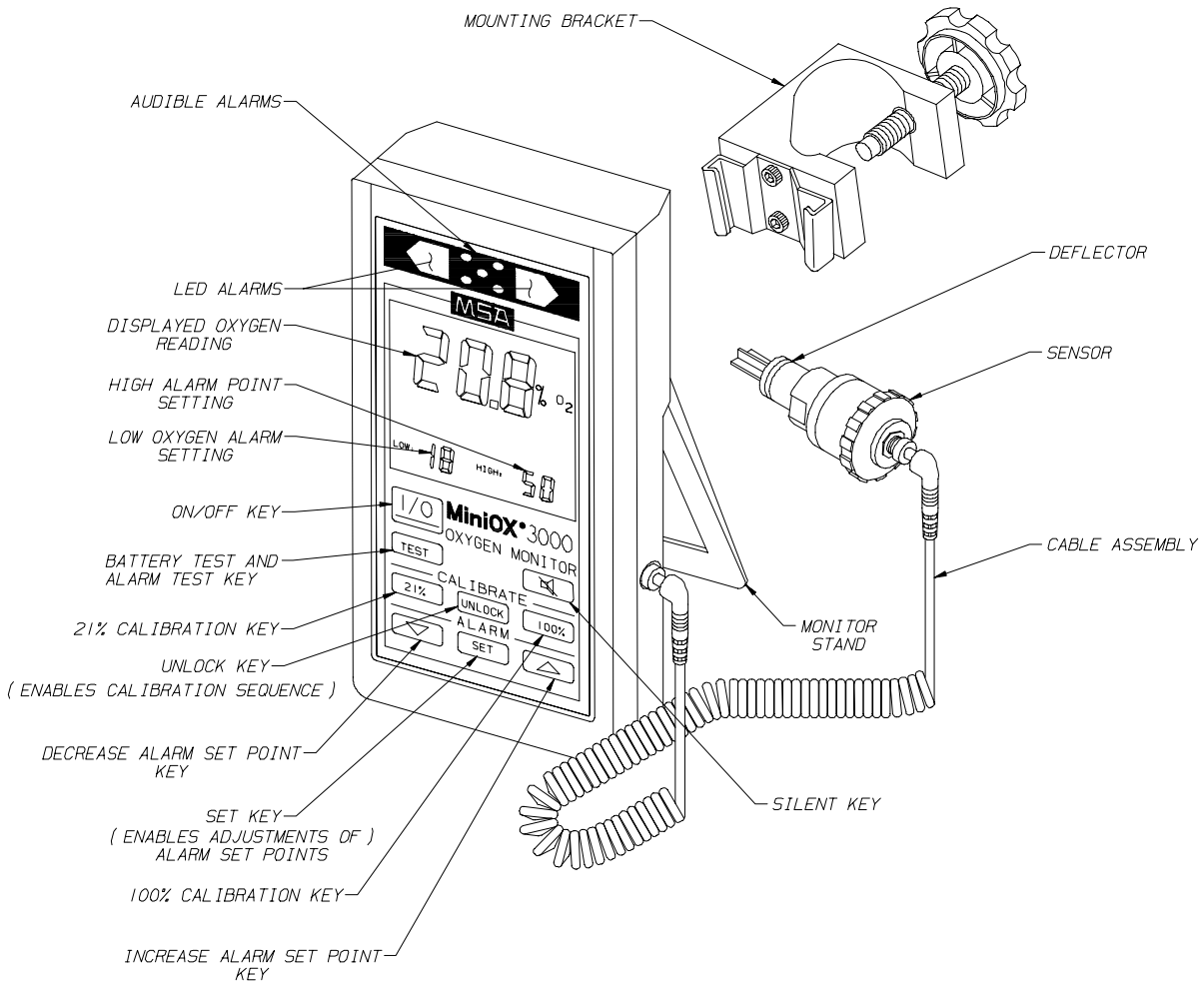

Figure 2-2.
Assembled Miniox 3000 Oxygen Monitor

Section 3
Operation

This section describes the following operational procedures and functions of the MiniOX 3000 Oxygen Monitor:

- Calibration
- Two-Point Linearity Check
- Setting the Alarms
- Alarm Conditions
- Silencing an Alarm
- Test Functions
- Installing the Sensor in a Breathing Circuit
- Mounting the Instrument with a Bracket.

Calibration

The MiniOX 3000 Oxygen Monitor requires calibration:

- daily, while in operation
- when the operating environment changes
- after the monitor is turned ON
- if the sensor is disconnected and reconnected to the instrument.

Recommended practice of calibration is against room air (defined as oxygen concentration of 20.8%). When a more precise measurement is desired, repeat calibration using 100% oxygen concentration. Changes in temperature, pressure, or humidity may affect calibration accuracy (see Appendix B, "Effects of Pressure, Humidity, and Temperature").

NOTE: Do not handle the sensor unnecessarily during calibration or use. Body heat can cause the sensor's thermistor to change disproportionately to the change in gas sample temperature at the sensing electrode. This can produce some error until thermal equilibrium is restored.

To Calibrate In Room Air (FIGURE 3-1):

1. Press **I/O** to turn ON the instrument.

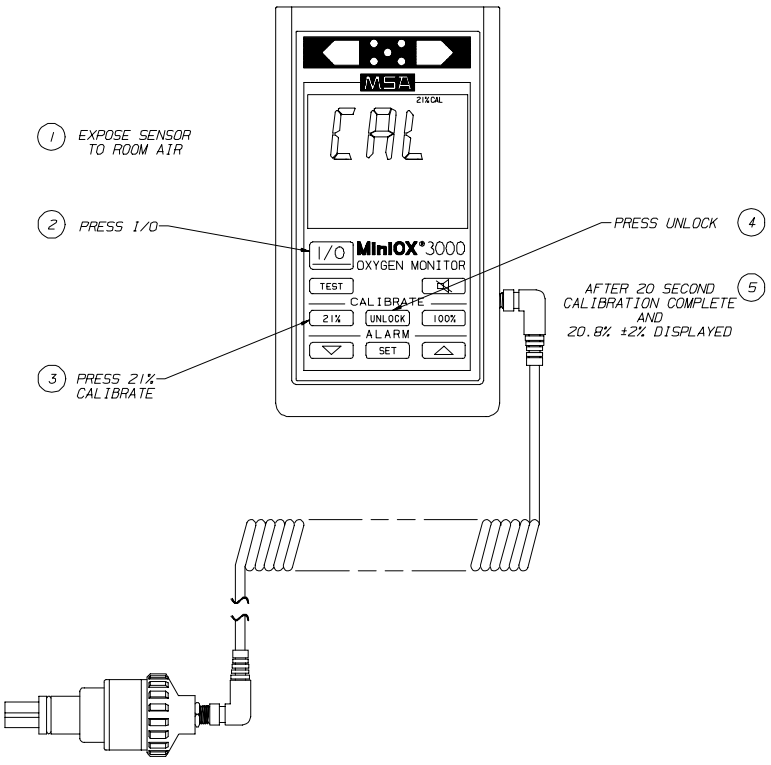

Figure 3-1.
Calibrating the MiniOX 3000 Oxygen Monitor in Room Air

- "CAL" flashes in the display.

2. Press **21%**. The following appears on the display:
   - "CAL"
   - "LOCKED"
   - "21% Cal."
3. Press **UNLOCK**. The following appears:
   - "CAL"
   - "21% CAL"
   - a 10-segment bar graph that "counts down" two seconds per bar for 20 seconds.
4. After 20 seconds, the calibration process is complete the device:
   - displays 20.8% ± 2% O_2 (18.8% to 22.8%)
   - proceeds to the monitoring mode
   - displays the current oxygen concentration as %O_2.

To Calibrate at 100 O_2% (FIGURE 3-2):

1. Calibrate in room air (see Section 3, "To Calibrate In Room Air").
2. Expose the sensor to 100% oxygen and allow the readings to stabilize prior to initiating the calibration.
   - "CAL" flashes in the display.
3. Press **100%**. The following appears on the display:
   - "CAL"
   - "LOCKED"
   - "100% Cal."
4. Press **UNLOCK**. The following appears on the display:
   - "CAL"
   - "100% Cal"
   - a 10-segment bar graph that "counts down" two seconds per bar for 20 seconds.
5. After 20 seconds, the calibration process is complete; the device:
   - displays 100.0% +0/-2% (98% to 100%)
   - proceeds to the monitoring mode
   - displays the current oxygen concentration as %O_2.

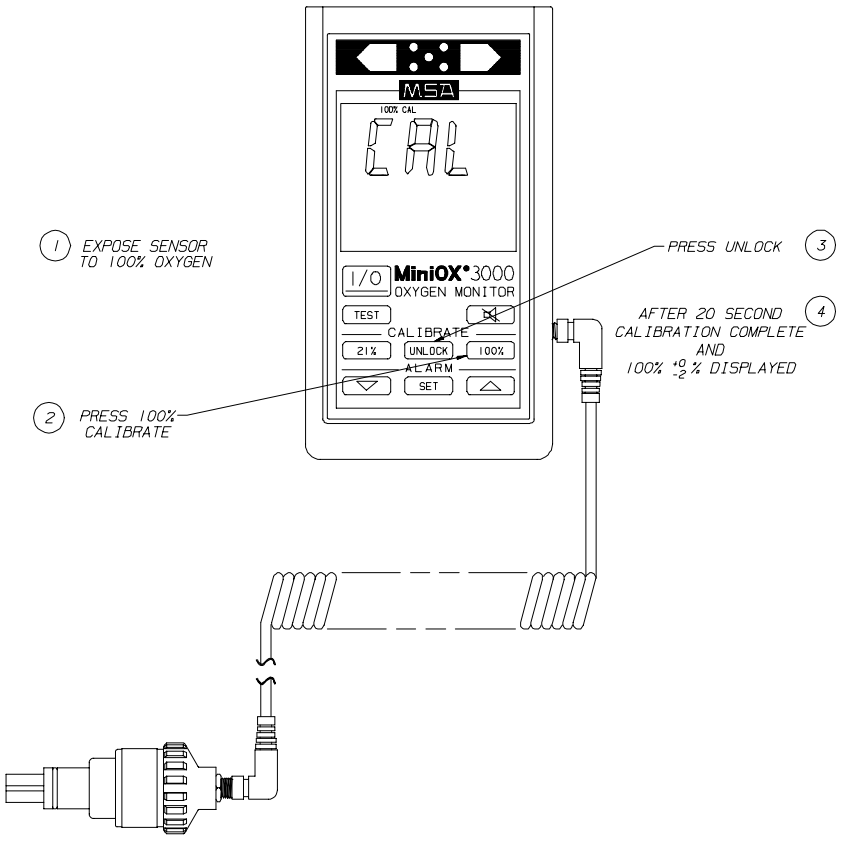

Figure 3-2.
Calibrating the MiniOX 3000 Oxygen Monitor in Room Air

NOTE: The MiniOX 3000 Oxygen Monitor has a five-second "time out" following keypad functions. If you do not press UNLOCK within five seconds, the instrument returns to the flashing "CAL" mode.

NOTE: During Calibration: if "CAL ERR" flashes in the display, visual, audible alarms activate, and then "CAL" flashes, turn OFF the instrument and repeat calibration procedure. When recalibrating, be sure to select the calibration value and use the corresponding calibration gas. If "CAL ERR" reoccurs, it may be necessary to replace the sensor. (See Section 4, "Sensor Replacement.")

NOTE: During Operation: if "CAL" displays, you must recalibrate the monitor. If "CAL" displays following proper recalibration, it may be necessary to replace the sensor. (See Section 4, "Sensor Replacement.")

Two-Point Linearity Check

To evaluate sensor performance, conduct a two-point linearity check on the monitor every week or any time you suspect that the sensor is not accurately reading oxygen concentrations. Acceptable range for room air measurement during a linearity check is:

- 20.8% ±2% (18.8% to 22.8%). This variation allows for differences in:
  - sampling methods
  - accuracy of gas concentration
  - precision of initial setting.

If linearity deviates more than ±2%, the sensor is nearing end-of-life and should be replaced.

To perform a two-point linearity check:

1. Calibrate in room air.
2. Place the sensor in a stream of oxygen with a known concentration of 100% until the reading stabilizes.
3. Recalibrate the monitor.
4. After calibration, measure room air. This reading should be 20.8% ±2% (18.8% or 22.8%) within five minutes.
   - If the variation is greater than ±2%, repeat the two-point linearity check.
   - If the variation is still greater than ±2%, replace the sensor. (See Section 4, "Sensor Replacement.")

Setting the Alarms

The default Alarm Setpoints are:

- 18% for Low Alarm (appears in the lower left corner of the display)
- 50% for High Alarm (appears in the lower right corner of the display).

These alarm points can be reset between 15% - 100%.

NOTE: The MiniOX 3000 Oxygen Monitor retains current alarm settings when turned OFF, if the alarm settings are not below 18%. However, if the alarm settings are less than 18% when the the MiniOX 3000 Oxygen Monitor is turned OFF or following battery replacement, alarm setpoints return to the default settings of 18% and 50%.

To Set the Low Alarm

This instruction manual applies to units with Serial Numbers greater than 777.

1. Press **SET** once. The following appears on the display:
   - "AL"
   - up/down arrows.
2. Using the arrow keys, scroll up or down to the desired Low Alarm setpoint (15% to 99%).
3. The MiniOX 3000 Oxygen Monitor "locks" this value. After five seconds the monitor:
   - beeps once
   - automatically proceeds to the Monitoring Mode.

NOTE: The Low Alarm CANNOT be disabled or set:
- below 15%
- above 99%
- higher than or equal to the High Alarm setting.

To Set the High Alarm

1. Press **SET** twice. The following appears on the display:
   - "AL"
   - up/down arrows.
2. Using the arrow keys, scroll up or down to the desired High Alarm setpoint (16% to 100%).
3. The MiniOX 3000 Oxygen Monitor "locks" this value. After five seconds, the monitor:
   - beeps once
   - automatically proceeds to Monitoring Mode. (Press **SET** once after Step 2 to manually proceed to Monitoring Mode).

NOTE: The HIGH Alarm value:

- CANNOT be set equal to, or less than, the Low Alarm value.
- CAN be disabled by increasing the alarm setpoint beyond 100% until "---" displays.

Alarm Conditions

High and Low Oxygen Concentration Alarms

When the MiniOX 3000 Oxygen Monitor detects an oxygen concentration that exceeds the preset alarm limit:

- the red LED flashes for that alarm (High or Low)
- an audible alarm activates
- the measured concentration displays.

Silencing an Alarm

The MiniOX 3000 Oxygen Monitor features a silence function that allows the operator to temporarily mute the O_2 concentration audible alarm.

1. When an audible alarm activates, press the **silent** key (labeled with a horn icon) to mute the alarm for up to three, 30-second intervals; press:
   - once for a 30-second interval
   - twice (within two seconds) for a 60-second interval
   - three times (within four seconds) for a 90-second interval.

   The following appears on the display:
   - a horn icon
   - a three-bar graph showing a "countdown" of 10 seconds per bar for each 30 second interval.

   NOTE: When the audible alarm is silenced, the appropriate visual alarm continues to flash.

   If the alarm condition is not corrected within the preset silence interval (30, 60, or 0 seconds):
   - the audible alarm reactivates.

   If the alarm condition is corrected and then reoccurs within this interval:
   - both audible and visual alarms activate.
2. To manually terminate the silence mode, press the **down** arrow (labeled with a ▲ icon).

Low Battery Alarms

The MiniOX 3000 Oxygen Monitor features a two-stage battery alarm that warns of depleted and expired battery voltage:

- The first alarm alerts the operator that the monitor has approximately six hours of operating time remaining:
  - "LOW BAT" appears on the display
  - an audible alarm sounds at 30-second intervals.
- If the operator does not replace the battery after this alarm, a second low battery alarm activates when the battery is no longer able to support monitoring.
  - the monitor displays "LOW BAT" and "---"
  - audible and visual alarms are activated.

For periodic checks on battery status, see Section 3, "Test Functions."

Sensor Indicator

During monitoring, the MiniOX 3000 Oxygen Monitor displays "SENSOR" and "OFF"; audible and visual alarms activate if:

- the oxygen sensor becomes disconnected
- the cable fails or disconnects from the sensor or instrument
- the sensor membrane is perforated
- the thermistor circuit opens.

Error Handling

The MiniOX 3000 Oxygen Monitor performs a self-test:

- when it is turned ON
- after a battery is installed.

If the microprocessor detects an error during these routine self-tests or during monitoring:

- the display flashes "ERR" and an error code
- audible and visual alarms activate
- the monitor ceases to operate until the appropriate service is performed; to reset the monitor, press **SET** or turn the monitor OFF, then ON (Press **I/O** twice). For further details see Appendix E, "Error Codes."

NOTE: During normal operation, if a key is pressed and held longer than nine seconds, audible and visual alarms activate.

1. To reset the monitor, press **SET** or turn the monitor OFF, then ON (Press **I/O** twice). For further details see Appendix E, "Error Codes."

TABLE 3-1 is a summary of MiniOX 3000 Oxygen Monitor alarms and status messages.

Table 3-1. Alarms and Status Messages

ALARM	CAUSE	CORRECTIVE ACTION
LOW O_2 Alarm: O_2 concentration appears, visual alarm flashes, and audible alarm activates	Oxygen concentration is below the preset Low Alarm setting	Check patient and delivered oxygen concentration
		Verify that low alarm setting is appropriate
HIGH O_2 Alarm: O_2 concentration appears, visual alarm flashes, and audible alarm activates	Oxygen concentration is above the preset High Alarm setting	Check patient and delivered oxygen concentration
		Verify that high alarm setting is appropriate
"SENSOR OFF" displays; visual and audible alarms activate	Cable is disconnected or malfunctioning	Check cable and sensor connections
	Sensor is disconnected	Visually check cable for damage. If necessary, replace the cable
	Sensor membrane is perforated	If alert reoccurs, replace the sensor
	Thermistor circuit is open on the sensor circuit board	If alert persists following sensor replacement, call MSA service
During calibration, "CAL ERR" flashes, visual and audible alarms activate, then "CAL" flashes	Calibration performed using a gas other than room air or 100% oxygen or wrong calibration key pressed (100%/21%).	Recalibrate the monitor; ensure proper calibration key pressed for calibration gas of room air or 100% oxygen
		If the alert persists, replace the sensor
		If alert persists following sensor replacement, call MSA service
During calibration, "CAL"" flashes	Sensor signal is out of monitoring range	Recalibrate the monitor; ensure proper calibration key pressed for calibration gas of room air or 100% oxygen
		If the alert persists, replace the sensor
		If alert persists following sensor replacement, call MSA service
"LOW BAT" displays and monitor beeps every 30 seconds	Monitor has approximately six hours of operating time remaining	Replace the battery as soon as possible; then, recalibrate the monitor and reset the high and low alarm values
"LOW BAT" displays, "---" flashes, and monitor activates visual and audible alarms	Battery is expired and monitor is not operating	Replace the battery; then, recalibrate the monitor and reset the high and low alarm values
"ERR" and error code (01 to 08) display, visual and audible alarms activate and monitor locks	Microprocessor detects internal error	Note error code and see Appendix E, "Error Codes"

Test Functions

Battery Test

In addition to alarms alerting the operator to low and expired battery voltage, the MiniOX 3000 Oxygen Monitor features a keypad function allowing the operator to check the relative battery life at any time. To test battery status:

1. Press **TEST** once. The following appears on the display:
   - "BATTERY TEST"
   - a 10-bar graph showing relative battery life. Ten bars indicate a fully charged battery; one bar indicates a battery near depletion.
2. After five seconds, the MiniOX 3000 Oxygen Monitor proceeds to the Monitoring Mode, displaying oxygen concentrations as $\%O_2$.

High and Low Alarms Test

The MiniOX 3000 Oxygen Monitor features a test function to ensure that the high and low alarms activate at the preset alarm levels. To test the alarms:

Press **TEST** twice.

- "ALARM TEST" displays
- the instrument automatically scrolls up to the high alarm value and flashes this value on the display
- the audible alarm and visual high alarm activate (If the high alarm value is disabled, the instrument scrolls down from 100 to the low alarm value)
- the instrument then automatically scrolls down to the low alarm value and flashes this value on the display
- the audible alarm and visual low alarm activate
- the Oxygen Monitor proceeds to the Monitoring Mode, displaying oxygen concentrations as $\%O_2$.

NOTE: The MiniOX 3000 Oxygen Monitor is not monitoring during the Alarm Test which may take up to 30 seconds to complete.

NOTE: The Alarm Test will not function if the Oxygen Monitor is in an alarm condition.

Installing the Sensor in a Breathing Circuit

To use the sensor in a breathing circuit, you will need the following:

- Sensor (with deflector)
- Tee adaptor

- Retaining strap

To install the sensor in a breathing circuit:

1. Install the tee adapter into the breathing circuit upstream from the humidifier. Make sure that side port of the tee adapter is facing upward
2. Remove the coiled cable from the sensor.
3. Firmly insert the sensor (with deflector) into the tee adaptor with the deflector pointing downward (FIGURE 3-3) to prevent moisture from condensing onto the sensor membrane; (See Appendix B, "Effects of Pressure, Humidity, and Temperature."). Make sure that the sensor fits tightly into the tee adaptor.
4. Install one end of the retaining strap over a post on the side of the tee adaptor.
5. Loop the strap over the sensor, inserting the strap center hole over the sensor cable jack.
6. Install the other end of the strap over the other tee adaptor post.
7. Re-attach the coiled cable to the sensor. Tighten the twist collar.

The sensor is securely placed for monitoring (See FIGURE 3-4).

Mounting the Instrument with a Bracket

The MiniOX 3000 Oxygen Monitor (as shown in FIGURE 3-5) can be attached to a vertical or horizontal pole using the MSA Mounting Bracket (see Appendix F, "Accessories/Replacement Parts"). To mount the MiniOX 3000 Oxygen Monitor:

1. Configure the bracket for either horizontal or vertical attachment by adjusting the dovetail mounting plate on the bracket.
2. Slide the mounting bracket onto the pole; secure by tightening the screw knob.
3. Slide the wedge on the back of the monitor into the dovetail mounting plate.

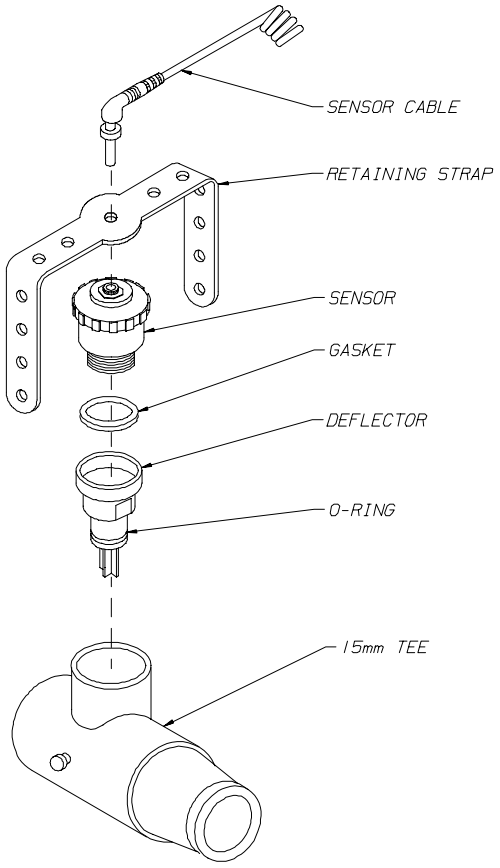

Figure 3-3.
Installing Sensor Into Tee Adaptor

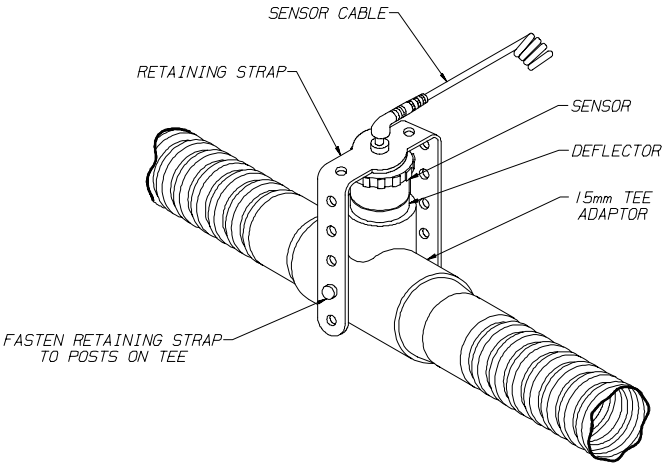

Figure 3-4.
Sensor In Breathing Circuit

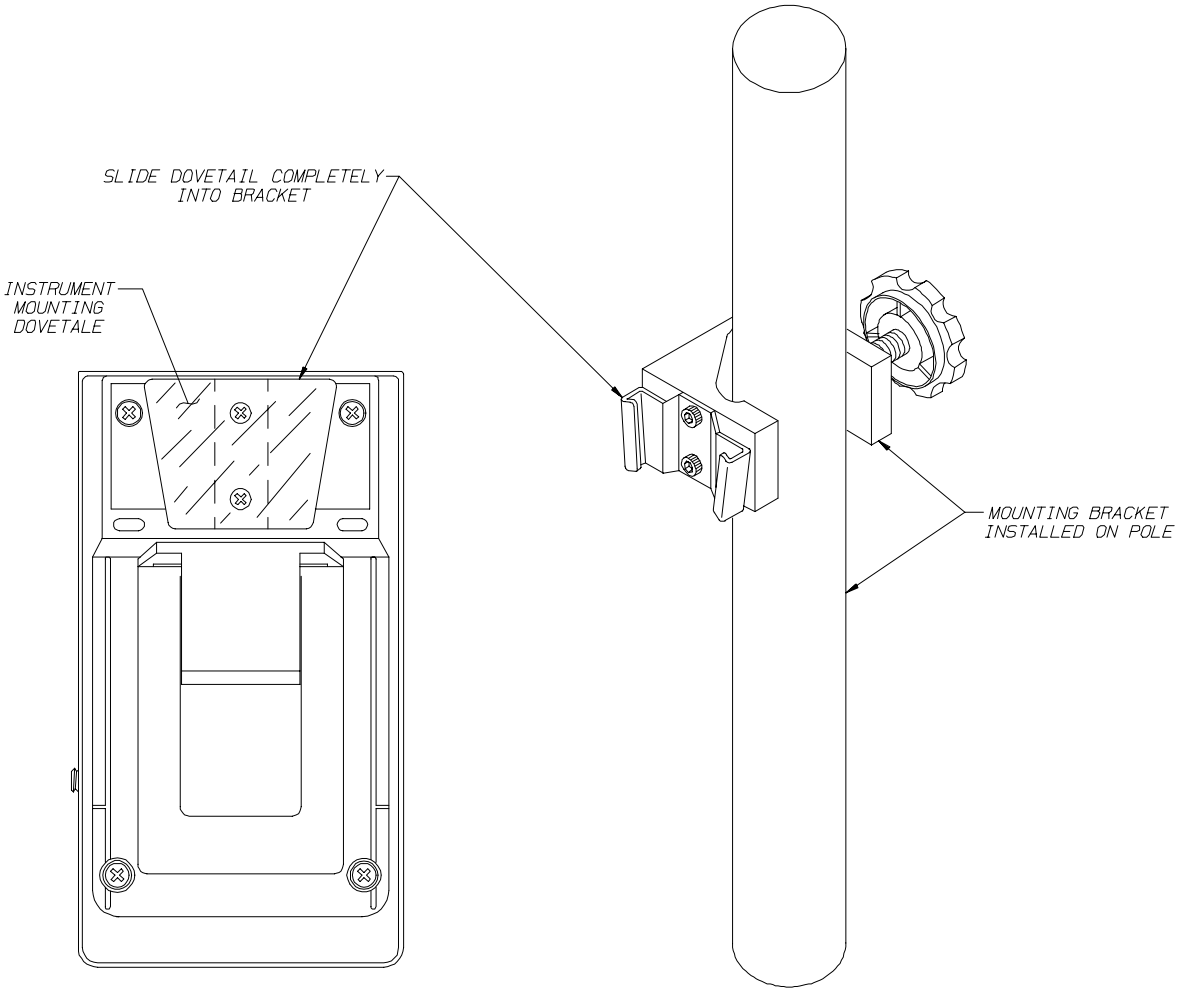

Figure 3-5.
MiniOX 3000 Oxygen Monitor with Mounting Bracket

Section 4
Maintenance and Care

⚠ WARNING

Use only genuine Mine Safety Appliances Company replacement parts when performing any maintenance procedures included in this manual. Failure to do so may seriously impair the monitor's performance. Repair or alteration of the MiniOX 3000 Oxygen Monitor beyond the scope of the maintenance instructions or by anyone other than an authorized MSA service person could cause the product to fail to perform as designed.

This section describes the following general maintenance and care procedures for the MiniOX 3000 Oxygen Monitor:

- Battery Replacement
- Sensor Replacement
- Deflector Replacement
- Cable Replacement
- Cleaning.

Battery Replacement

The MiniOX 3000 Oxygen Monitor requires one standard 9-volt alkaline battery. To replace the battery:

1. Verify that the monitor is turned OFF. The display should be blank.
2. Pull out the support stand from the back of the case.
3. Unscrew the two screws on the battery cover in the back of the instrument and remove cover.
4. Remove the battery from the case and unsnap the battery from the battery holder.

   NOTE: To ensure proper start-up, wait at least 45 seconds before connecting the fresh battery to the battery connector.
5. Snap the terminal of the new battery into the battery holder.
6. Install the battery cover and screw into place. Make sure that the battery cover is properly seated and flat on the back of the MiniOx 3000 Oxygen Monitor case.
7. Recalibrate the monitor. Reset the low and high alarms, if desired.

   NOTE: To maximize battery life, press **I/O** to turn OFF the MiniOX 3000 unit when not monitoring. In order to retain alarm settings, do not remove battery.

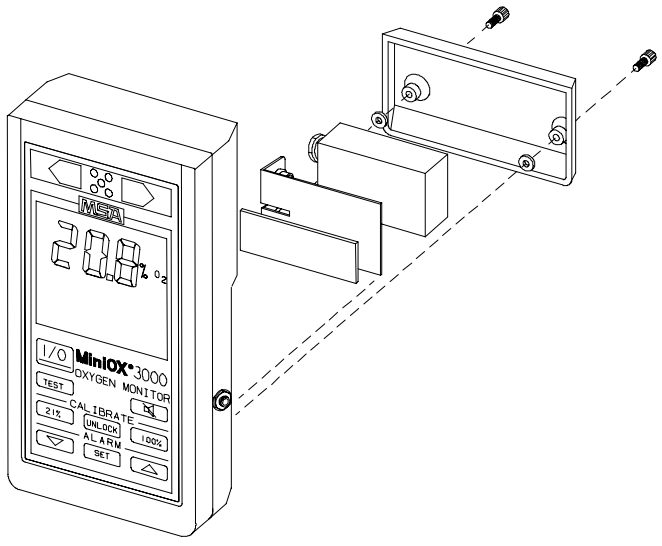

Figure 4-1.
Battery Cover Removal

Sensor Replacement

Replace the sensor when:

- Room air reading is greater than 20.8% ±2% (18.8% to 22.8%) in Two-Point Linearity Check.
- The MiniOX 3000 Oxygen Monitor will not calibrate.
- "Sensor" and "OFF" display and audible and visual alarms persist when sensor and cable connections are correct and cable is viable.

To replace the sensor:

1. Verify that the monitor is turned OFF. The display should be blank.
2. Disconnect the expired sensor from the coiled cable.
3. Attach a new sensor to the coiled cable and firmly press the connector until the sensor snaps into place. Tighten the twist collar.
4. Recalibrate the monitor.

Deflector Replacement

To replace the deflector:

1. Gently unscrew the old deflector and remove the gasket.
2. Insert a new gasket into the large end of the new deflector. Carefully screw the new deflector onto the sensor, making sure that the new gasket is properly seated.

See FIGURE 3-3 for proper sensor and deflector assembly.

Cable Replacement

To replace the coiled cable:

1. Verify that the monitor is turned OFF. The display should be blank.
2. Disconnect the old cable from the sensor.
3. Disconnect the old cable from the instrument.
4. Attach the new cable to the sensor. Firmly press the connector until the sensor snaps into place. Tighten the twist collar.
5. Attach the new cable to the instrument. Firmly press the connector until it snaps into place. Tighten the twist collar.
6. Recalibrate the instrument.

Cleaning

⚠ CAUTION

Never autoclave, immerse, or expose the MiniOx 3000 Oxygen Monitor (including sensor) to high temperatures (>70^{0}C). Never expose the device to pressure, irradiation, vacuum, steam, or chemicals (other than alcohol or mild cleaning agents).

Clean the instrument and sensor by wiping with a cloth lightly dampened with Isopropyl Alcohol or mild detergent. Make sure that no moisture seeps into the instrument case or cable jack port.

Disinfection and Sterilization

Instrument

When cleaning or disinfecting the instrument, care must be taken to prevent entry of solutions into the instrument case. If it is suspected that solutions or moisture enters the case, verify performance by conducting a self-test (see Appendix D).

Cleaning

The external surfaces of the unit may be cleaned by wiping them with a cloth moistened with a mild detergent solution.

Disinfection

The external surfaces of the unit may be disinfected by wiping them with a cloth moistened with ethanol or Cidex. The instrument is not designed to withstand the conditions imposed by steam, ethylene oxide or radiation sterilization.

Sensor and Cable

Cleaning

The external surfaces of the oxygen sensor and of the cable may be cleaned by wiping them with a cloth moistened with a mild detergent solution.

Disinfection

The external surfaces of the oxygen sensor housing and of the cable may be disinfected by wiping them with a cloth moistened with ethanol or Cidex. The instrument is not designed to withstand the conditions imposed by steam, ethylene oxide or radiation sterilization.

Sensor Deflector, Retaining Strap and Tee Adapter

The Sensor Deflector, Retaining Strap and Tee Adapter may be cleaned by wiping them with a cloth moistened with a mild detergent solution. The parts must be thoroughly dry before they are used.

Disinfection

The sensor deflector, retaining strap and tee adapter may be disinfected by washing them with ethanol or Cidex (per manufacturer's instructions). The parts must be thoroughly dry before they are used.

Sterilization

The sensor deflector, retaining strap and tee adapter may be sterilized using Cidex (per manufacturer's instructions), steam or ethylene oxide. Due to the varying conditions imposed on materials during sterilization, it is not possible to determine the exact number of times sterilization processes can be carried out. Therefore, the operator must carefully examine the oxygen deflector, retaining strap and tee adapter after sterilization and prior to use to verify that the item is fit for use. The operator must verify that the items are free from tears and cracks and that the items have not undergone any materials changes that may compromise their fitness for use (e.g., brittleness and dimensional changes). The operator must also examine the items to verify that the items are free of chemical residuals resulting from the sterilization process.

Because of the variability of cleaning, disinfection and sterilization processes, MSA cannot provide specific sterilization instructions, nor can the sterility of an item be ensured.

Section 5
Servicing Equipment

⚠ WARNING

Use only genuine Mine Safety Appliances Company replacement parts when performing any maintenance procedures included in this manual. Failure to do so may seriously impair the monitor's performance. Repair or alteration of the MiniOX 3000 Oxygen Monitor beyond the scope of the service instructions or by anyone other than an authorized MSA service person could cause the product to fail to perform as designed.

You will need these tools to service the MiniOX 3000 oxygen monitor:

- 3/8" nut driver
- #1 Phillips screwdriver
- Standard screwdriver
- Static-dissipative service kit (static-mat, ground cord and wrist strap)
- 44-Pin PLCC Extraction Tool.

⚠ CAUTION

To protect electrostatic-sensitive equipment, service personnel must use a static-dissipative service kit and must follow all electrostatic discharge (ESD) procedures and precautions before servicing the monitor.

This section describes how to disassemble and reassemble (FIGURE 5-1 and TABLE 5-1) the MiniOX 3000 Oxygen Monitor's:

- Instrument Case
- Printed Circuit Board
- Liquid Crystal Display
- Programmed Integrated Circuit

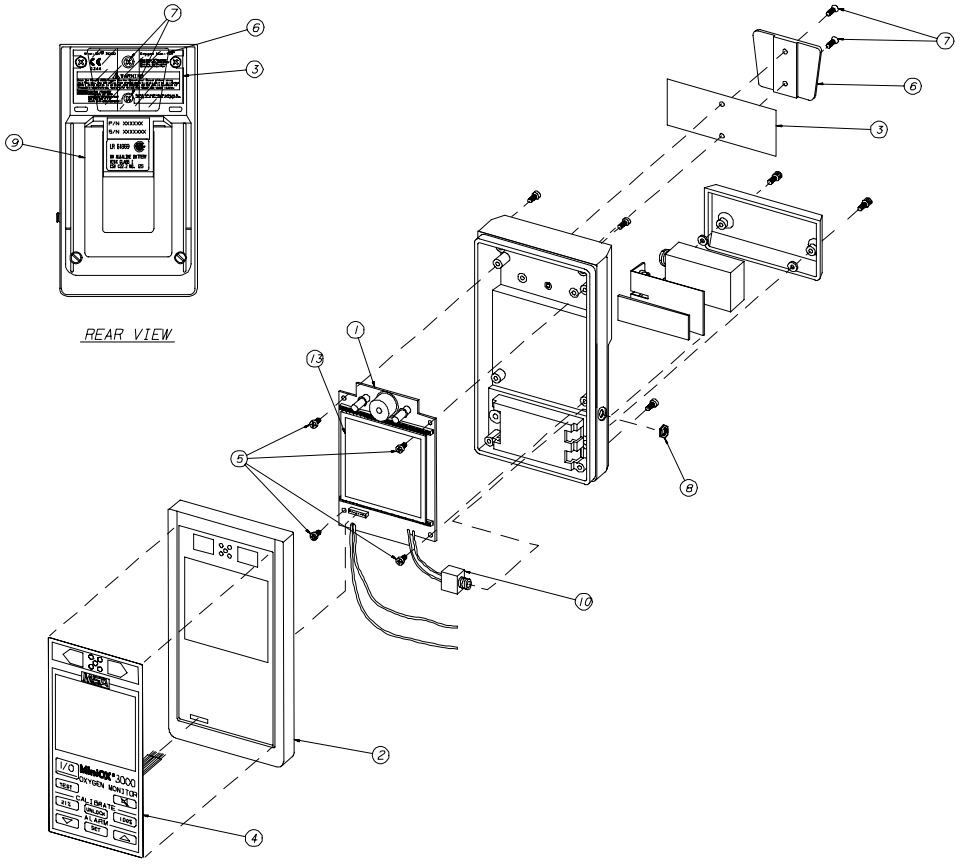

Figure 5-1.
MiniOX 3000 Oxygen Monitor Assembly (See Table 5-1 for Corresponding Part Numbers and Description)

- Monitor Stand.

Table 5-1. MiniOX 3000 Parts List

(NOTE: Reference Figure 5-1.)

ITEM	PART NO.	DESCRIPTION
1	815290	Printed Circuit Board Assembly
2	814361	Instrument Case (Includes: Font Cover, Back Cover, Battery Cover and Monitor Stand)
3	814356	Back Label
4	814357	Keypad/Front Label
5	655087	Screw, Thread Forming, #4 1/4" Lg.
6	474606	Dovetail
7	631553	Screw, #6-32 1/4" Lg.
8	655030	Nut, Polycarbonate
9	655033	Monitor Stand
10	066730	Single Jack
11	710974	Battery Cover Assembly
12	814355	LCD

MiniOX 3000 Oxygen Monitor Disassembly

Perform the following instructions to disassemble the MiniOX 3000 Oxygen Monitor. Refer to the exploded view of the instrument (FIGURE 5-1), as required. Unless otherwise noted, item numbers given in these procedures refer to the TABLE 5-1 Parts List for FIGURE 5-1.

Battery Cover and Battery Removal

1. Verify the unit is turned OFF. The display should be blank.
2. Pull out the support stand from the back of the unit.
3. Unscrew the two screws on the battery cover in the back of the unit and remove the cover (FIGURE 5-2).
4. Remove the battery from the case and unsnap the battery from the holder.

Front Cover Enclosure Removal

1. Remove the instrument's battery cover as previously described.

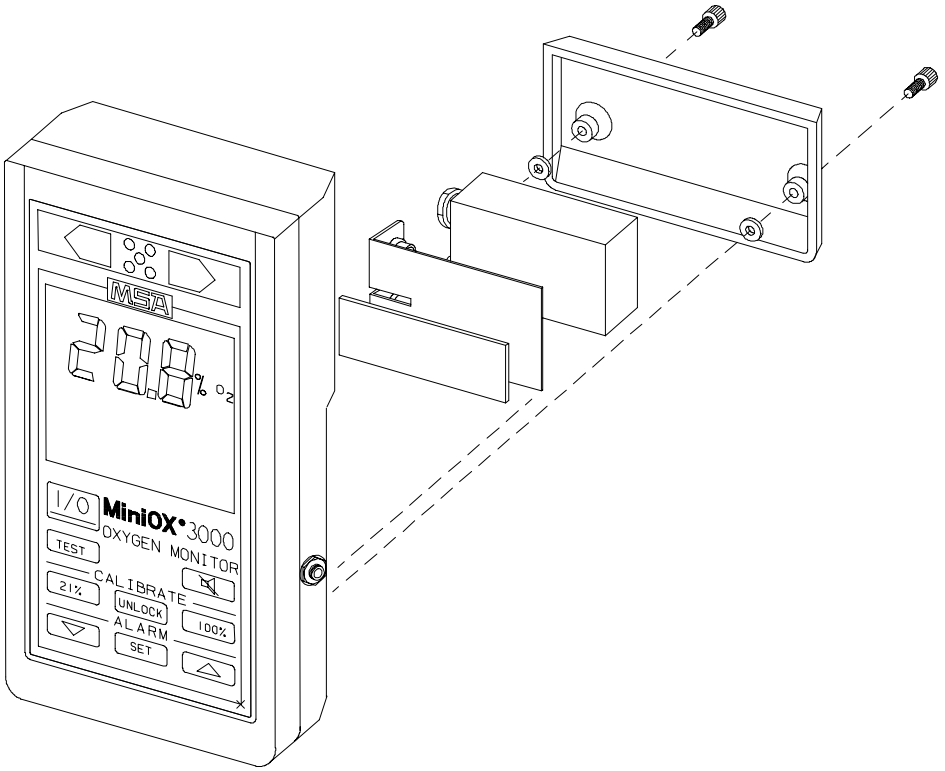

Figure 5-2.
Battery Cover Assembly

2. Place the unit face down on a flat working surface.
3. Using a Phillips screwdriver, remove the four screws near the edges of the unit.
4. Grasp the enclosure front cover (FIGURE 5-1, Item 2) and lift.

   NOTE: Take care not to pull the flexible keypad connector from the circuit board).

5. Pull the outer shell of the circuit board keypad connector (FIGURE 5-3, Item J4) to release the keypad connection.
6. Unsolder the two battery holder wires.
7. Remove the front cover from the unit.

Circuit Board Assembly Removal

⚠ CAUTION

The internal circuit board is sensitive to electrostatic discharge (ESD). Proper grounding of the technician and workstation is necessary to prevent damage to the circuitry.

1. Remove the battery cover and the front cover.
2. Using a 3/8" nut driver, remove the nut (FIGURE 5-1, Item 8) from the enclosure back cover (FIGURE 5-1, Item 2)
3. Using a Phillips screwdriver, remove the four screws near the edges of the circuit board.
4. Remove the circuit board from the enclosure back cover (FIGURE 5-1, Item s 1 and 2).
5. Place the circuit board assembly in an ESD-safe area.

Liquid Crystal Display (LCD) Replacement

1. Remove the battery cover and front cover.
2. Remove the LCD (FIGURE 5-1, Item 13) only if it must be replaced or to update the programmed integrated circuit (IC).

   NOTE The LCD is made of thin glass and is very fragile. If the LCD is removed, take care not to bend or damage the LCD legs.

3. Using a non-metallic tool, a small blade or rod made of plastic or wood (such as a tongue depressor), carefully pry up the LCD by working around the edges of the part and

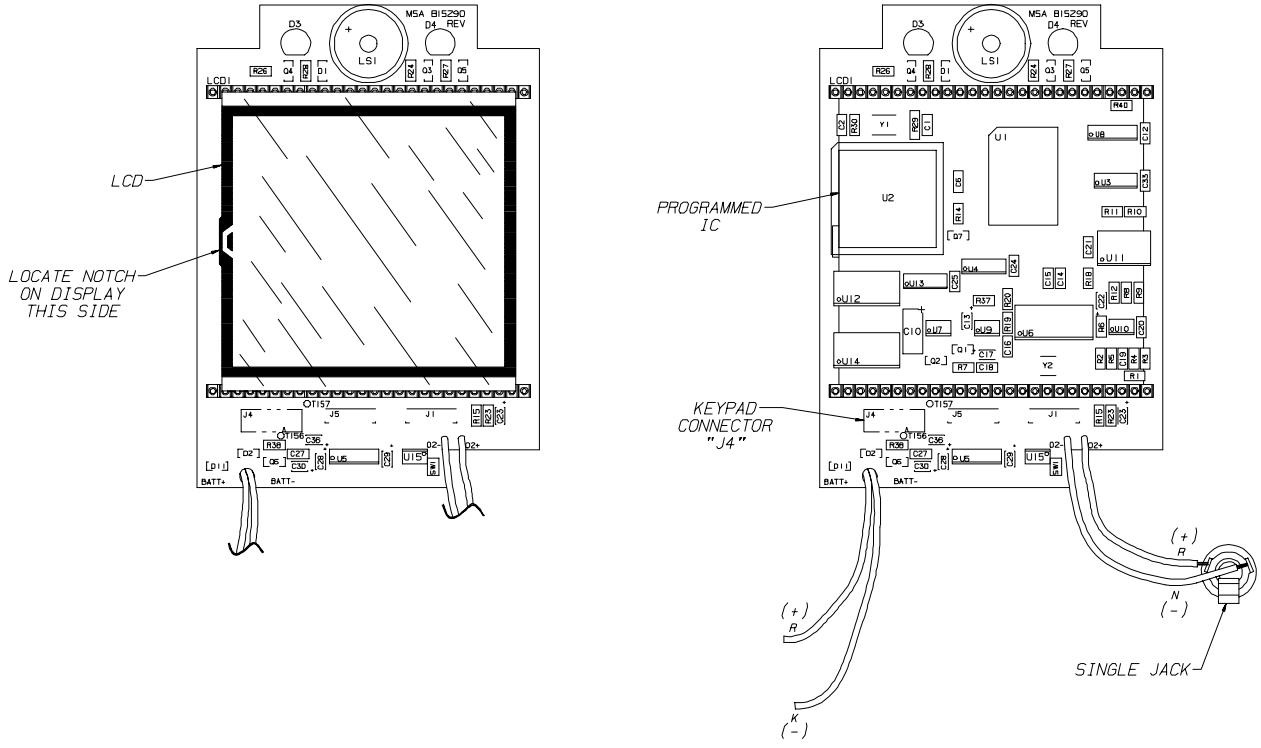

Figure 5-3.
Circuit Board Assembly

gradually lifting the LCD until it can be pulled from the socket (FIGURE 5-3).

4. Note the alignment notch on the replacement LCD to determine proper orientation (FIGURE 5-3). Carefully install the replacement LCD.

5. Perform the following instructions to reassemble the MiniOX 3000 Oxygen Monitor.

MiniOX 3000 Oxygen Monitor Reassembly

Perform the following instructions to reassemble the MiniOX 3000 Oxygen Monitor. Refer to the exploded view of the instrument (FIGURE 5-1), as required. Unless otherwise noted, item numbers given in these procedures refer to the TABLE 5-1 Parts List for FIGURE 5-1. If the LCD or a plug-in IC was removed from the circuit board assembly, verify that the replacement part has been inserted and seated firmly in the socket. Be certain that the alignment notch or pin 1 mark (FIGURE 5-3) shows proper alignment.

Circuit Board Assembly Installation

1. Place the back cover of the enclosure on a flat working surface.
2. Position the circuit board assembly (FIGURE 5-1, Item 1) so the back cover mounting holes are centered with the circuit board mounting holes.
3. Insert the four screws (FIGURE 5-1, Item 5) into the holes in the back cover and tighten.
4. Solder the two battery leads to the battery holder (red lead to the solder lug of the larger battery terminal).
5. Feed the sensor connector through the back cover mounting hole (FIGURE 5-1).
6. Using a 3/8" nut driver, apply the nut (FIGURE 5-1, Item 8) to the enclosure back cover (FIGURE 5-1, Item 2).

Front Enclosure Cover Installation

1. Place the enclosure back cover on a flat working surface.
2. Align the enclosure front cover over the back enclosure cover.
3. Gently insert the front cover flexible keypad connector into the back cover circuit board keypad connector. Push the outer shell of the circuit board connector into the board to lock the connector.
4. Place the front cover into the back cover as shown in the exploded view of the unit (FIGURE 5-1).
5. Insert the four screws into the holes in the back cover and tighten.

Battery Cover and Battery Installation

1. Snap the the battery terminal into the battery holder.
2. Slide the battery into the case until it rests flat in the battery holder.
3. Install the battery cover and screw into place (FIGURE 5-2). Make sure the battery cover is properly seated and flat on the back of the unit.

Updating Firmware

General

Operating software for the MiniOX 3000 Oxygen Monitor is in the form of firmware contained in a programmed integrated circuit (IC). A version code is printed on a label placed on the IC. The firmware can be updated by installing a replacement programmed IC (P/N 710275) on the circuit board.

Programmed IC Replacement

Follow any special instructions accompanying the replacement programmed IC. Otherwise, perform the following general instructions. FIGURE 5-3 shows the IC's outline and markings.

1. Remove the battery cover, front cover, LCD, and circuit board assembly by performing the disassembly procedures given in this section.
2. Locate the programmed IC on the circuit board assembly (FIGURE 5-3). The IC is marked with an identifying label (FIGURE 5-4).
3. Using a removal tool for a 44-pin integrated circuit, carefully extract the programmed IC.

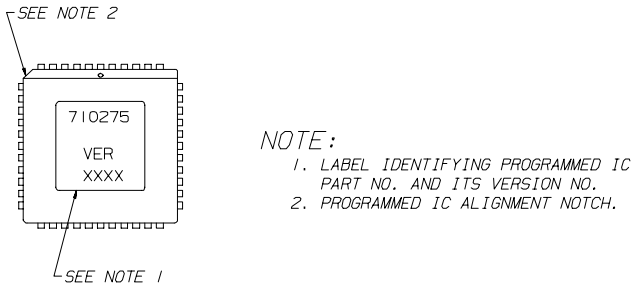

Figure 5-4.
Programmed Integrated Circuit

4. Note the alignment notch on the replacement IC to determine proper orientation (FIGURE 5-4). Using a 44-pin integrated circuit insertion tool, carefully install the replacement IC.

5. Following the instructions previously given in this section, reassemble the MiniOX 3000 Oxygen Monitor.

Monitor Stand Replacement

1. Remove the battery cover, front cover, and circuit board assembly by performing the disassembly procedures given in this section.

3. Using a Phillips screwdriver, remove the two screws centered on the enclosure back cover (FIGURE 5-1).

4. Replace the original monitor stand with the new monitor stand (P/N 655033).

5. Insert the two screws into the holes in the enclosure back cover and tighten.

6. Following the instructions given previously in this section, reassemble the MiniOX 3000 Oxygen Monitor.

Appendix A
Specifications

Table A-1. Specifications		
O_2 ALARM SYSTEM	LOW/HIGH O_2 ALARM	Pulsating alarm, flashing LEDs
ACCURACY		±1% of full scale (RTP*) as calibrated in the environment of use (total accuracy, including linearity, is 2%)
LINEARITY		±1% of full scale (RTP*)
NOMINAL RESPONSE TIME (O_2 directed at sensor at 2 liters per minute at RTP)		90% in 20 seconds
		97% in 30 seconds
SENSOR LIFE		Over one year in normal medical conditions (nominal 750,000 O_2 hours)
SENSOR SHELF LIFE		Six months minimum (stored in sealed package)
BATTERY LIFE		Approximately 1500 device hours, assuming 80% ON, 20% OFF
OPERATING TEMPERATURE RANGE		0°C to 40°C (32°F to 104°F)
STORAGE TEMPERATURE		-40°C to 70°C (-40°F to 158°F)
HUMIDITY		5% to 95% RH (non-condensing)
DIMENSIONS	INSTRUMENT	152 x 83 x 33 mm (5.98 x 3.26 x 1.31 in.)
	SENSOR	OD 30.56 mm (1.2 in.); Length: 43.2 mm (1.7 in.)
WEIGHT	INSTRUMENT	260 g (9.2 oz.)
	SENSOR	36 g (1.25 oz.)
BATTERY ALARM SYSTEM	STAGE 1	Warning that approximately six hours of monitoring life remain; LOW BAT appears on display; beep sounds every 30 seconds until battery is replaced or Stage 2 occurs.
	STAGE 2	Alarm that proper operation is not assured; monitor shuts down, audible and visual alarms are activated.
	***RTP: Room temperature and pressure, e.g., 23°C ±3° and ambient barometric pressure**	

Appendix B
Effects of Pressure, Humidity and Temperature

⚠ CAUTION

To ensure accurate and reliable oxygen monitoring, it is necessary to have a thorough understanding of the effects of pressure, humidity, and temperature on the sensor.

Effects of Pressure

The sensor responds to partial pressure (not percentage) of oxygen. Changes in barometric pressure change the reading, even if the percent of oxygen in the sample remains constant.

Partial pressure of oxygen (PO_2) equals the percent of oxygen ($\%O_2$) times the pressure at which the sample is measured (mmHg).

$$PO_2 = (\%O_2)\ (mmHg)$$

For example: at sea level, the pressure equals 760 mmHg and dry air contains 21% O_2. Therefore:

$$PO_2 = (21\%)\ (760\ mmHg)$$

$$PO_2 = 160\ mmHg$$

If you calibrate an instrument to read 21% at 760 mmHg partial pressure and then take the instrument to an area above sea level, a lower reading occurs due to a lower partial pressure. For a pressure of 700 mmHg:

$$PO_2 = (21\%)\ (700\ mmHg)$$

$$PO_2 = 147\ mmHg$$

The percent reading on the instrument is derived from the following formula:

$$\frac{PO_2\ Actual}{PO_2\ Sea\ level} = \frac{147\ mmHg}{160\ mmHg}$$

When PO_2 sea level is 21%

$$PO_2\ Actual = \frac{(21\%)\ (147\ mmHg)}{(160\ mmHg)} = 19.3\%$$

Therefore, to eliminate error due to pressure changes, the instrument must be calibrated at the pressure in which it is used.

⚠ CAUTION

Do not expose the sensor to pressure outside the range of 600 to 900 mmHg (23.62 to 35.43 inches Hg), as this may cause inaccuracies.

Effects of Humidity

The presence of humidity in an oxygen sample decreases the actual concentration of oxygen. Humidity in a sample has the same effect as diluting the sample with another gas. For example, if 100% oxygen is saturated with 100% humidity, the actual concentration of oxygen drops to 96% - 97%.

As with all oxygen gas sensors, condensation on the sensor membrane blocks the flow of oxygen, resulting in a lower oxygen concentration reading and an increased response time. This is a typical problem resulting from locating the sensor downstream from the humidifier in an oxygen delivery system; clearing the sensor face and deflector restores normal operation. However, to avoid this problem when using the sensor in a breathing circuit, position the sensor upstream of the humidifier and mount the sensor with the deflector pointing downward to prevent moisture from draining onto the sensor membrane.

Effects of Temperature

Due to an internal thermistor (temperature variable resistor), the MiniOX 3000 sensor is minimally affected by temperature change. Variations in the sensor reading from temperature change are less than 3% when the instrument is calibrated and used in a monitoring environment of 0°C to 40°C (32°F to 104°F).

NOTE: Do not handle the sensor unnecessarily. Body heat can cause the sensor's thermistor to change disproportional to the change in gas sample temperature at the sensing electrode. This may produce some error until thermal equilibrium is restored.

Appendix C
Interferant Gases and Vapors

Table C-1. Interferant Gases and Vapors

INTERFERANT	VOLUME % DRY	INTERFERENCE EQUIVALENT OF % O_2
Carbon Dioxide	10%	0.1%
Cyclopropane	50%	0.2%
Desflurane	7.5%	0.1%
Diethyl Ether	20%	0.3%
Enflurane	4%	0.1%
Halothane	5%	0.2%
Helium	80%	0.2%
Isoflurane	3%	0.5%
Methoxyflurane	4%	0.1%
Nitrogen	80%	0.2%
Nitrous Oxide	80%	0.1%

Appendix D
Troubleshooting

Table D-1. Troubleshooting

PROBLEM	CAUSE	CORRECTIVE ACTION
Display is blank.	Monitor is turned OFF or Battery is expired.	Press I/O to turn ON monitor.
		If monitor does not respond, replace the battery.
		If problem persists, call MSA service.
No response to keypad commands.	Battery is expired.	Press I/O to turn ON monitor.
		If monitor does not respond, replace the battery.
		If problem persists, call MSA service.
"SENSOR OFF" displays and visual and audible alarms activate.	Cable is disconnected or malfunctioning.	Check cable and sensor connections.
	Sensor is disconnected.	Visually check cable for damage. If necessary, replace cable.
	Sensor membrane is perforated.	If alert reoccurs, replace sensor.
	The thermistor circuit is open on the sensor circuit board	If alert persists following sensor replacement, call MSA service.
During calibration, "CAL ERR" flashes, visual and audible alarms activate; then, "CAL" flashes.	Calibration performed using improper calibration values or improper calibration gas.	Recalibrate the monitor, ensuring proper calibration values and gas.
		If alert persists, replace sensor.
		If alert persists following sensor replacement, call MSA service.
During operation, "CAL" flashes.	Sensor signal is out of monitoring range.	Recalibrate the monitor, ensuring proper calibration values and gas.
		If alert persists, replace sensor.
		If alert persists following sensor replacement, call MSA service.
"LOW BAT" displays and monitor beeps every 30 seconds.	Monitor has approximately six hours of operating time remaining.	Replace the battery as soon as possible; then recalibrate the monitor and reset the high and low alarm values.
"LOW BAT" displays, "---" flashes, both visual alarms activate, and monitor emits a three-tone beep for four minutes; monitor shuts OFF.	Battery is expired and monitor is not operating.	Replace the battery; then, recalibrate the monitor and reset the High and Low Alarm values.
"ERR" and error code (01 to 08) display. Visual and audible alarms activate; monitor locks.	Microprocessor detects internal error.	Note error code and see Appendix E, "Error Codes."
		Disconnect battery.
		Call MSA service.
Possible physical damage to instrument	Instrument is dropped and/or exposed to fluids	Turn instrument OFF, then ON to initiate self-test. If instrument is damaged, "ERR" and error code (01 to 08) display. Disconnect battery. Call MSA service.

Appendix E
Error Codes

The MiniOX 3000 Oxygen Monitor performs diagnostic tests to detect errors that could cause unreliable monitor operation. These tests are performed:

- when a battery is installed (power-up)
- when the monitor is turned ON
- during routine monitoring.

During self-test or any time the monitor detects an operational error, the MiniOX 3000 Oxygen Monitor:

- ceases operation
- displays "ERR" and an error code
- activates visual and audible alarms.

ERROR ALARMS CONTINUE UNTIL:

1. THE MONITOR IS SHUT OFF (PRESS I/O)
2. THE MONITOR IS RESET AND ERROR DOES NOT REOCCUR (PRESS SET)
3. THE BATTERY IS DISCONNECTED.

If an error reoccurs, the monitor is inoperative and must not be used; call MSA Repair at:

800-672-4678 extension 8642.

The error code that appears on the display corresponds to a specific failure. The audible alarm is a beep that corresponds to this code (e.g., "ERR 3" triggers a three-beep alarm).

Table E-1. Error Codes

ERROR DISPLAY	CORRESPONDING ERROR
01	System error
02	Random Access Memory (RAM) error
03	Read Only Memory (ROM) error
04	Analog error
05	Timing (COP) error
06	Keypad error*
07	Battery error **
08	LCD error
*Press SET. If error reoccurs, call MSA Repair.	
**Replace battery. If error reoccurs, call MSA Repair.	

Appendix F
Accessories and Replacement Parts

Table F-1. Accessories and Replacement Parts	
ITEM	PART NO.
Oxygen Sensor	406931
Mounting Bracket	474664
Coiled Cable	472045
Tee Adaptor	473021
Retaining Strap	634249
Operation Manual	814358
MiniOX 3000 Oxygen Monitor	814365

Appendix G
Parts List

Table G-1. Parts List	
ITEM	PART NO.
MiniOX 3000 Printed Circuit Board Assembly	815290
LCD	814355
Single Jack	066730
Instrument Case (Includes: Font Cover, Back Cover, Battery Cover and Monitor Stand)	814361
Back Label	814356
Keypad	814357
Battery Cover Assembly	710974
Monitor Stand	655033
Deflector	803229
Dovetail	474606